



A Status Update for the FLASHFlux Working Group

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*Tonya Davenport and Fenny Wang and the
Atmospheric Science Data Center Team (SSAI)*



CERES FLASHFlux Overview

- **FLASHFlux Overview**

- Uses CERES based production system through inversion;
 - Quarterly calibration updates projected forward; running 3-day TISA
 - Running 30-day SiBi
- LPSA/LPLA SOFA algorithms for surface fluxes; 3-day running TISA window

- **FLASHFlux Latency Objectives**

- SSF products within 3-4 days
- Global 1x1 daily averages from FF TISA; goal: 5-7 days latency

- **FLASHFlux Community Usage**

- Primarily used for applied science and education (i.e., POWER and Globe Clouds)
- Supports also QC for selected missions (e.g., NOAA NESDIS)
- TOA gridded fluxes; normalized to TOA EBAF for annual “State of the Climate” assessments (current under review).



FLASHFlux Data Delivery via POWER Web Services Portal (2021/03/01 to 2022/02/28)

Orders including FLASHFlux as Delivered via POWER

	Total	Monthly
Unique Users IPs	~62.1 K (59%)	~5.2 K
Requests	~16.3 M (60%)	~1.36 M

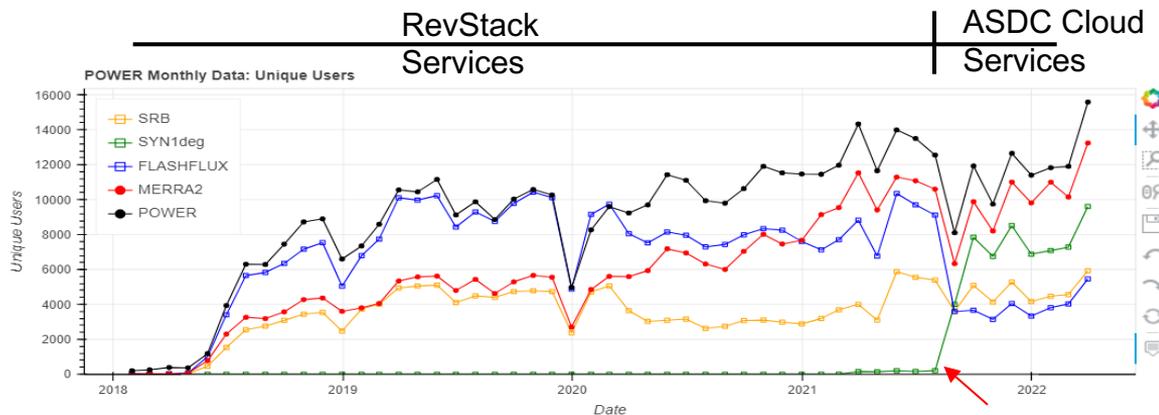
All Orders in of CERES Delivered via POWER

	Total	Monthly
Unique Users IPs	~105.7 K	~8.8 K
Requests	~ 27.1 M	~2.25 M

(includes SYN1Deg from Jan 2001 through latest month released)



Dot density map showing locations of users (red) and data request locations (white). Brighter colors show larger frequency at that location.





FLASHFlux Operational Status

- **FF Production status:**

- Current Status: SSF Terra: 4/23/22; SSF Aqua: 4/23/22; TISA: 4/21/22
- Updated calibration coefficients received; promoted as cc change effective 4/1/22

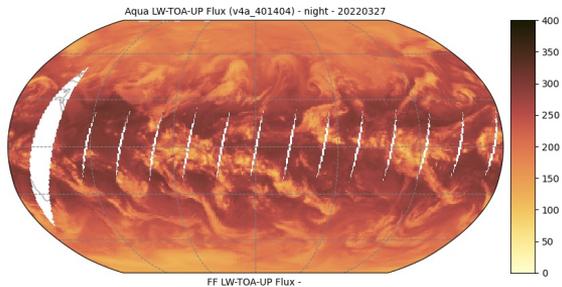
- **FF Operational Issues:**

- Striping anomaly in Aqua; 17-18 min, every 3 hours; minimal impact
- Aqua outage: March 31 – April 15
 - Occurred midway on March 31 (12 GMT and later)
 - MODAPS now releasing data from April 16, but CERES and MODIS instruments still warming up (MODAPS assessing science quality for 4/16-4/17, recommended waiting 48 – 72 hours)
 - Began Aqua SSF production again from April 17 (see plots - looks ok)
- FF TISA processed in “Terra-only” mode from March 31; resumed a “Terra+Aqua” TISA product beginning with 4/18

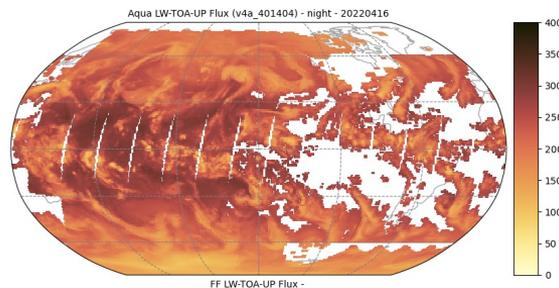


Aqua SSF - TOA LW Upward – Nighttime ($W m^{-2}$)

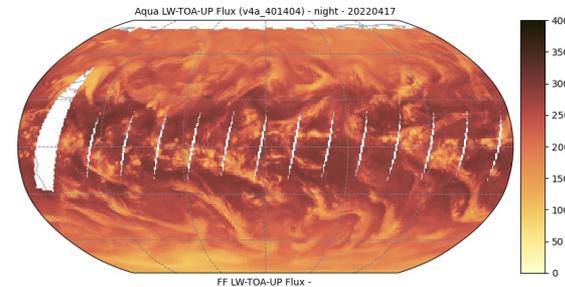
03.27.2022



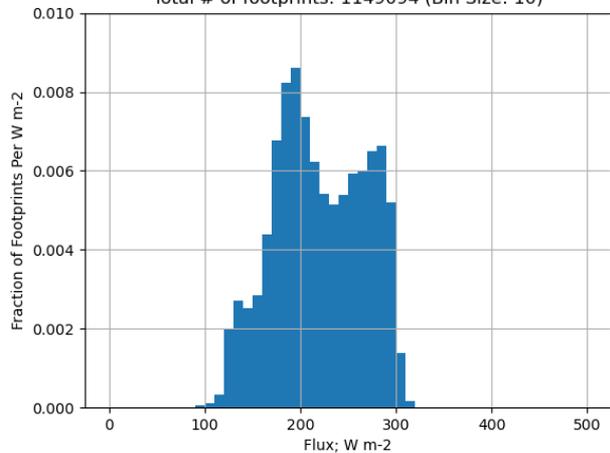
04.16.2022



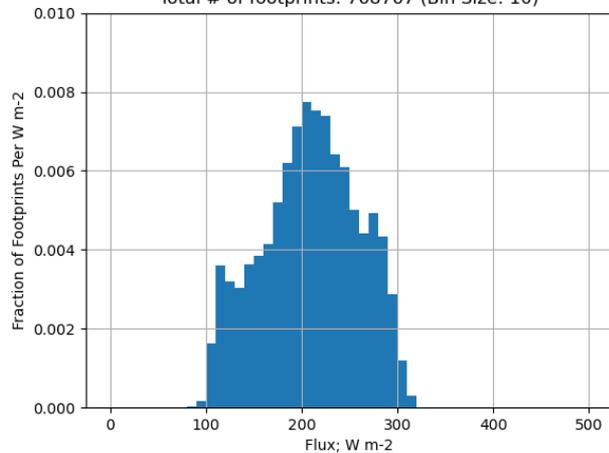
04.17.2022



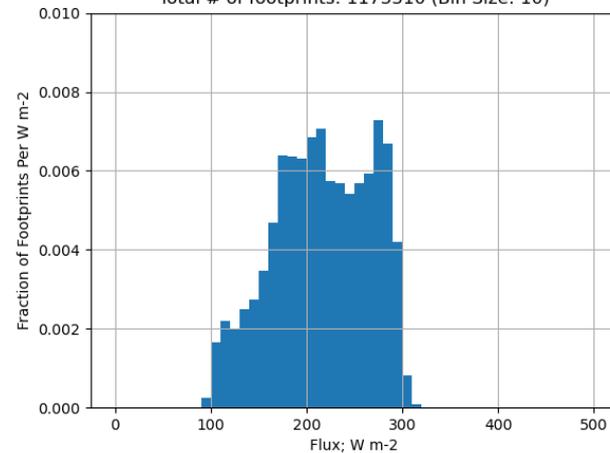
Aqua v4a_401404 lw-toa-up - 20220327 - nighttime
Total # of footprints: 1149094 (Bin Size: 10)



Aqua v4a_401404 lw-toa-up - 20220416 - nighttime
Total # of footprints: 768767 (Bin Size: 10)



Aqua v4a_401404 lw-toa-up - 20220417 - nighttime
Total # of footprints: 1173310 (Bin Size: 10)





FLASHFlux (v4A) SSF Latency Assessment

Success rate % of time < 3 (dark/thick bar) or 4 days (lighter/thinner bar)

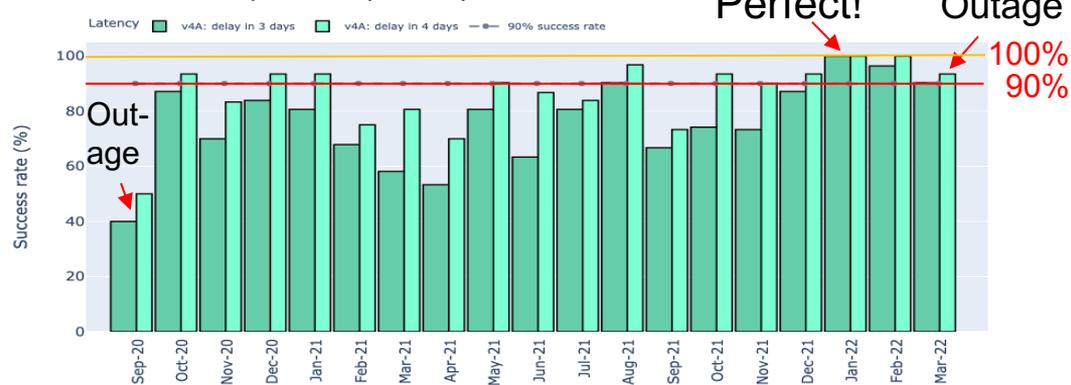
In last year, Terra had 7 months at or exceed 90% of days at 4 day latency; Aqua had 8

Jan and Feb 2022 provided all SSF within 4 days => perfect months!

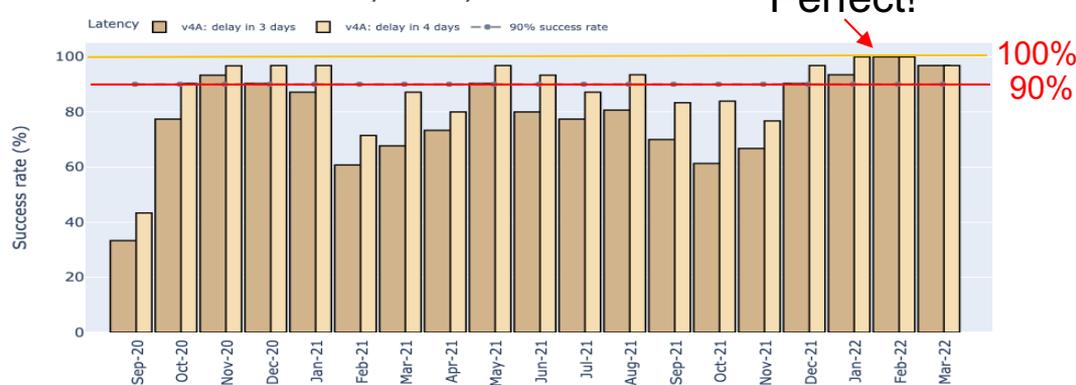
Lags due to: maneuvers/ satellite issues, ASDC updates/outages

SSF utilized by GLOBE Clouds; occasional satellite algorithm comparisons (i.e., NOAA GOES ABI)

FLASHFlux SSF Aqua Monthly Latency Success Rates



FLASHFlux SSF Terra Monthly Latency Success Rates

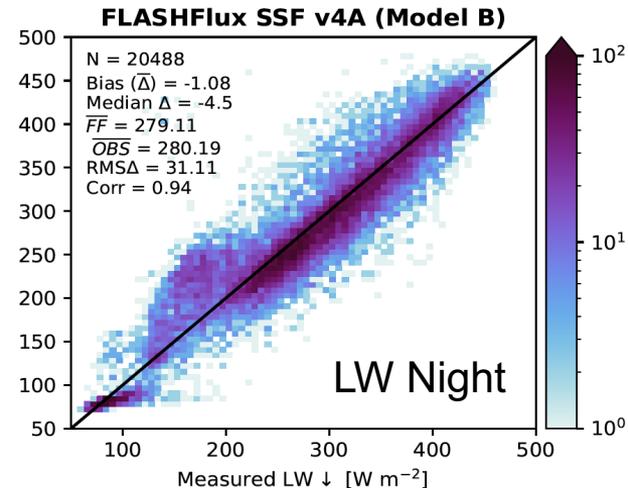
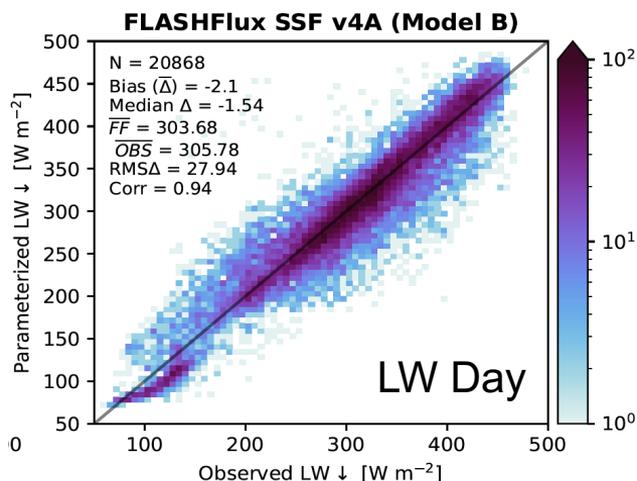
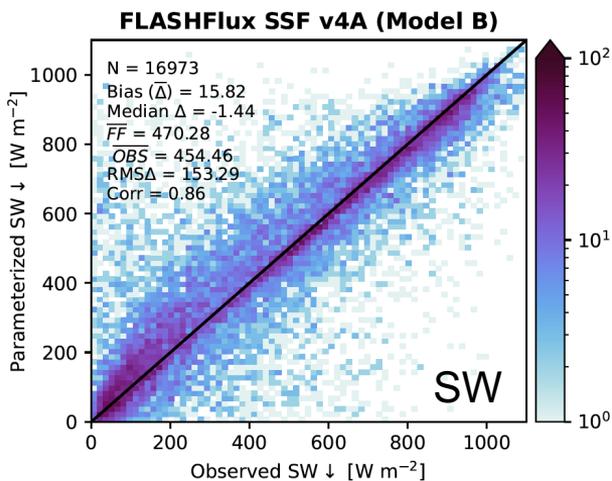




FF SSF Flux Validation: Aqua

Overpass flux validation with BSRN measurements (R. Scott):

- large SW scatter; underpredicts $> \sim 300 \text{ W m}^{-2}$; overestimates low
- LW night has larger scatter; instantaneous performing adequately

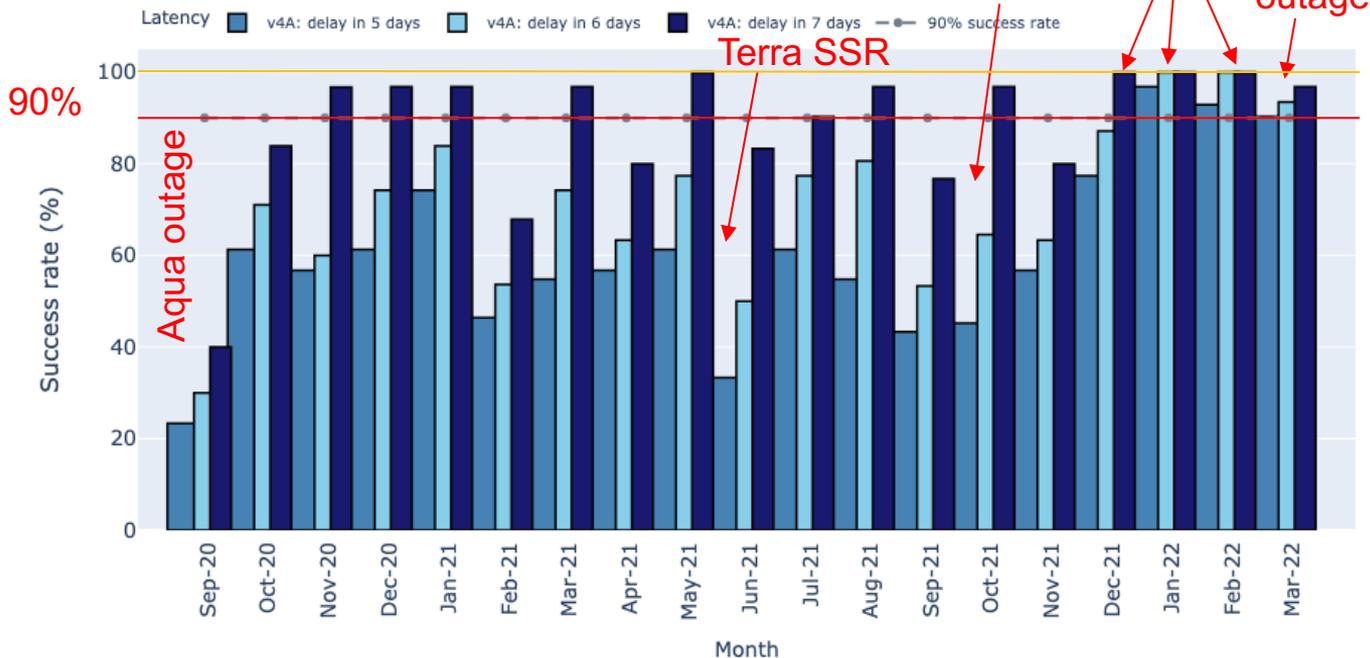




FLASHFlux TISA Latency Assessment

FF v4A

FLASHFlux TISA Monthly Latency Success Rates



Perfect!

Success rate % of time 5 (med blue), 6 (light blue) or 7 days (dark blue) latency

Jan and Feb reached 100% at 6 day latency; 8 of 12 months at 7 day > 90%

Last 3 months reached 90% of days available at 5 day latency!

Lags due to: maneuvers, ASDC updates/outages

TISA delivered to POWER Web Services Suite



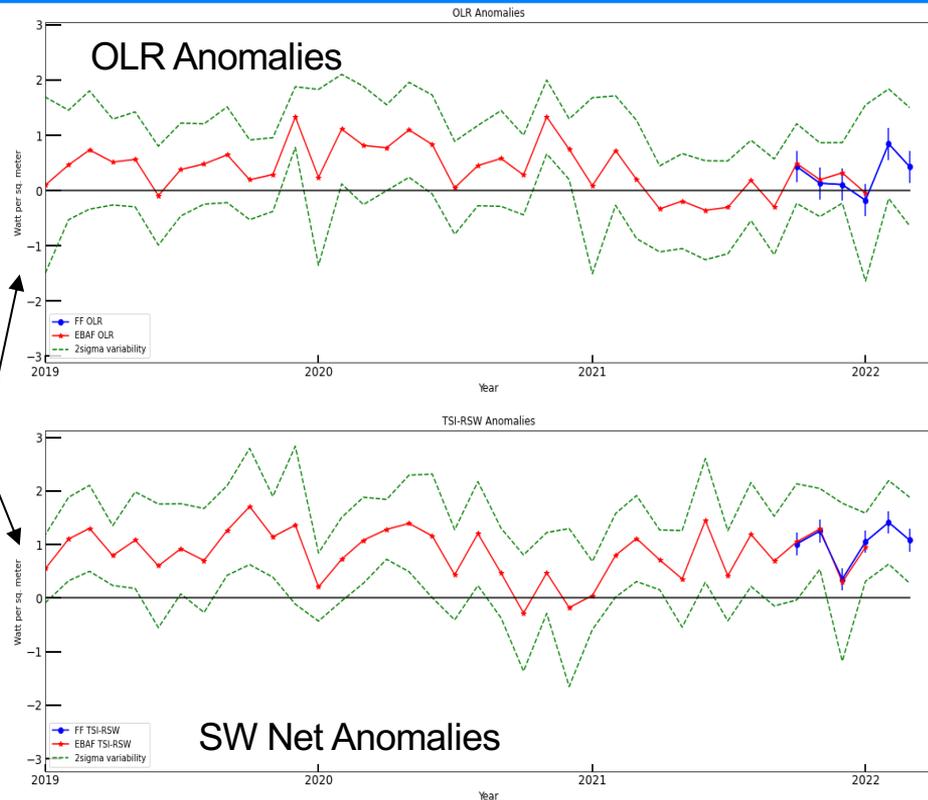
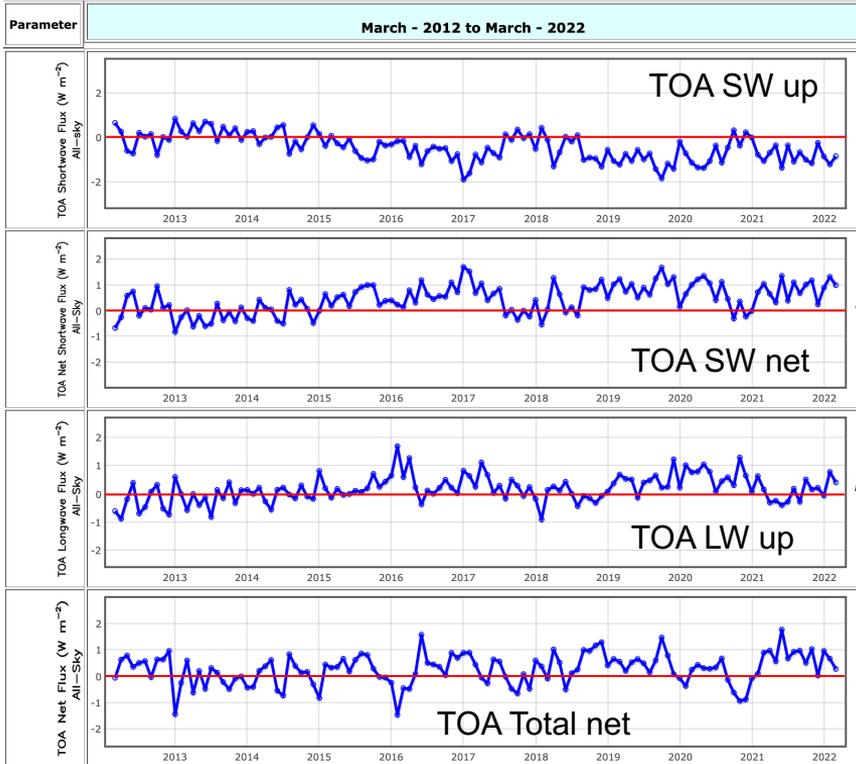
Global Anomalies: EBAF + FF (Normalized)



EBAF_FF/ANOM_CERES_EBAF-FF_Ed4.1 - Global Data Charts

March - 2012 to March - 2022

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FLASHFlux TISA Validation: BSRN Fluxes

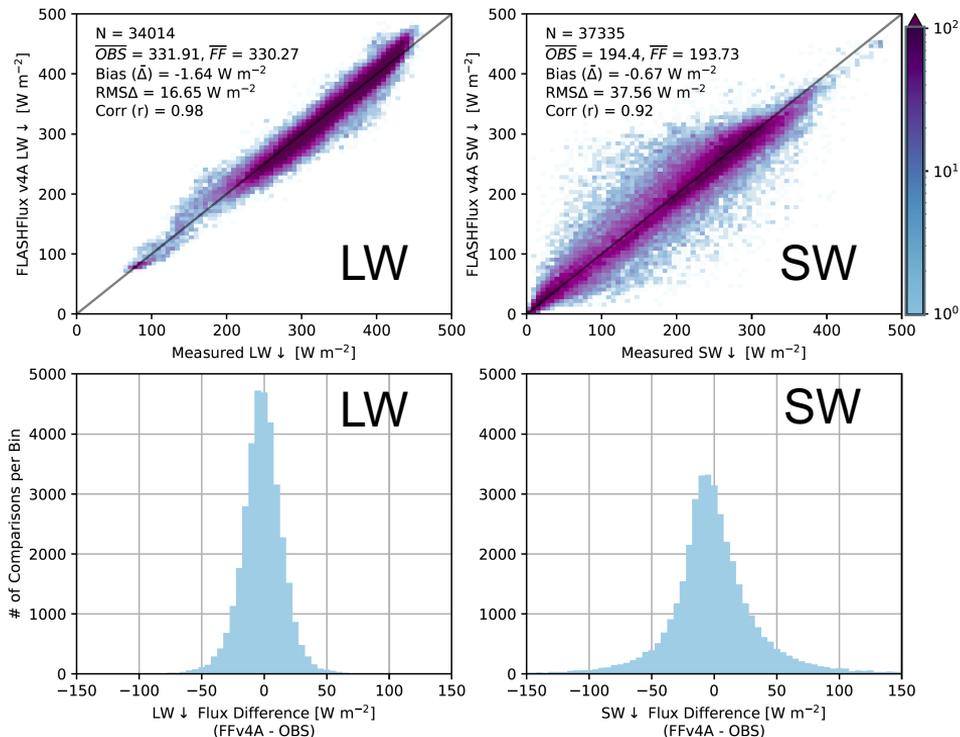
Ensemble FLASHFlux LW and SW
Daily Average Comparisons to BSRN
Measurements (1/2019-12/2021)

LW: Bias -1.6 W m^{-2}
RMS 16.7 W m^{-2}

SW: Bias -0.7 W m^{-2}
RMS 37.6 W m^{-2}

Histograms show peaked, relatively
symmetric distributions, median bias
is negative bias for SW, LW

FLASHFlux TISA Version 4A
All Surface Validation Sites, 201901-202112
Daily Average Fluxes





FLASHFlux TISA Validation: BSRN and Ocean Buoy Fluxes

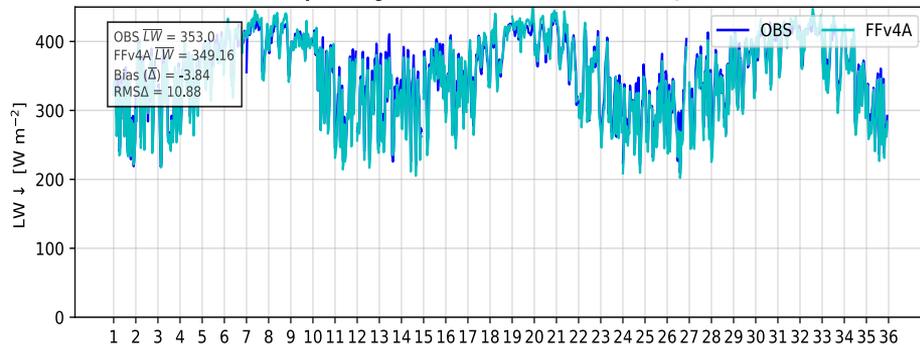
FLASHFlux v4A TISA Daily Average Fluxes (1/2019 – 12/2021)

Region Type	LW Bias	LW RMS	# LW Pairs	SW Bias	SW RMS	# SW Pairs
All Ensemble	-1.6	16.7	34,024	-0.7	37.6	37,335
Coastal	0.3	15.0	7707	-1.9	34.1	7460
Desert	-11.1	21.8	2883	-12.1	28.2	2861
Island	5.9	14.4	2055	18.5	46.3	2009
Continental	-3.6	17.2	12828	-4.9	38.9	12755
Polar	0.7	19.6	3505	-7.5	48.3	2389
Ocean buoys	1.0	12.4	5036	6.7	35.7	9861

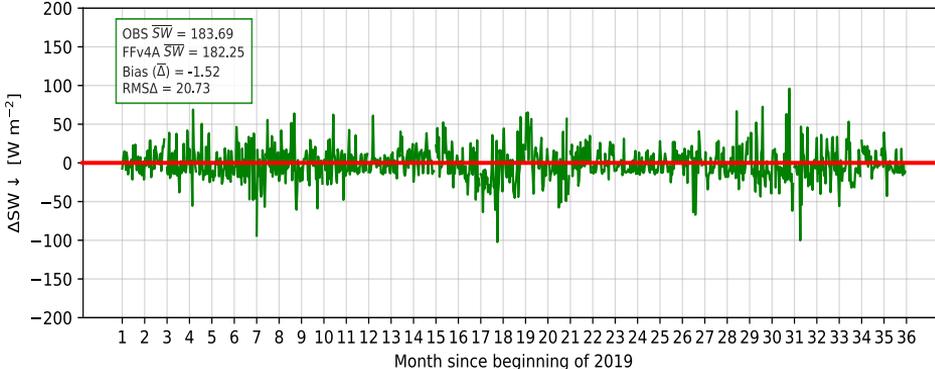
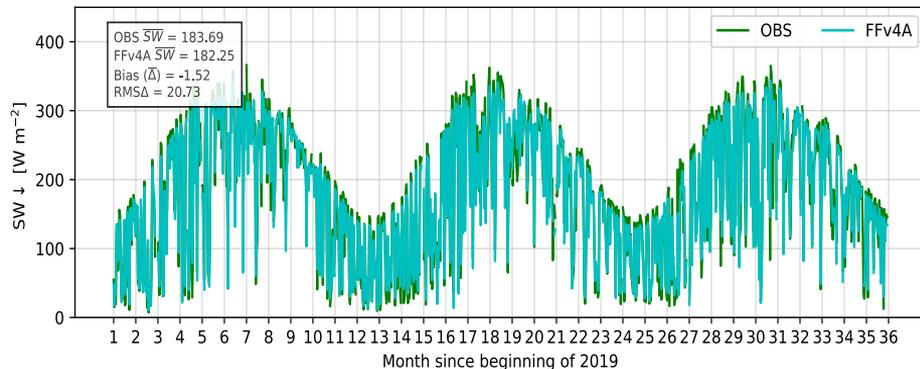
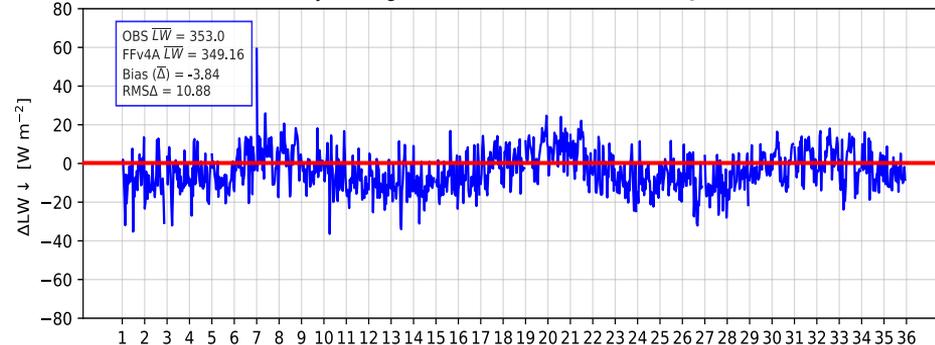


FF Time Series (Goodwin Creek, MS, USA)

FLASHFlux TISA Version 4A
Daily Average FFv4A and OBS Surface Flux @ GCR



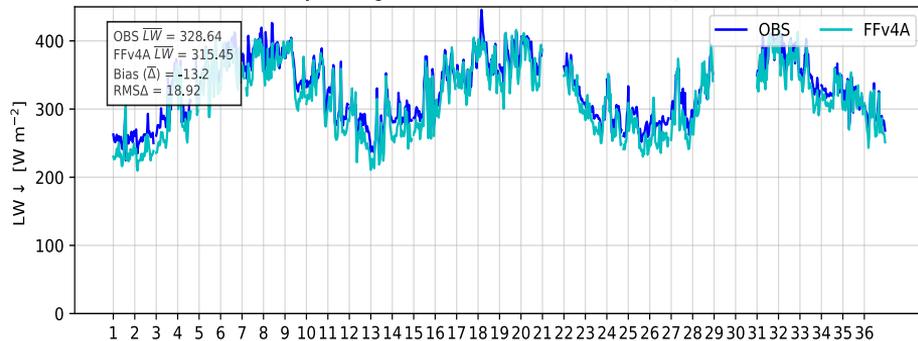
FLASHFlux TISA Version 4A
Daily Average Surface Flux Δ (FFv4A - OBS) @ GCR



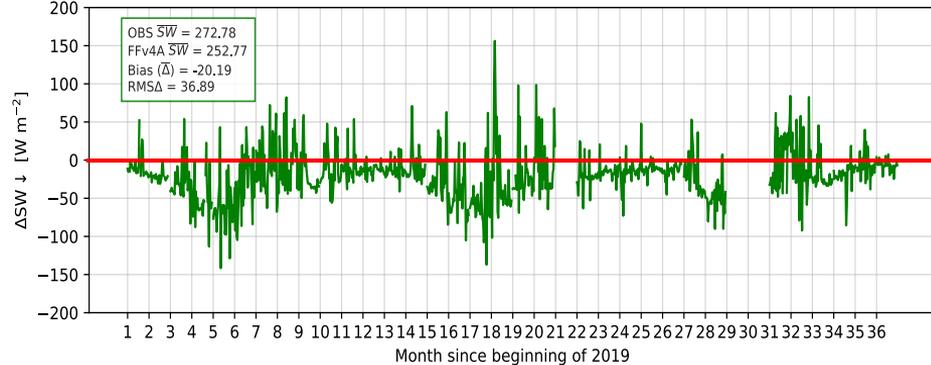
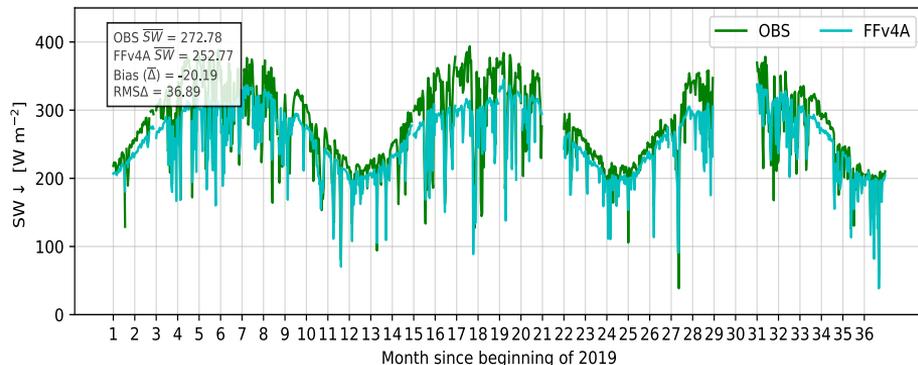
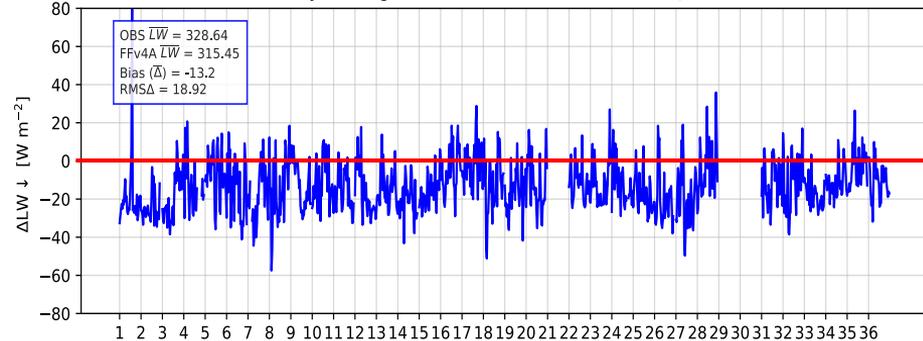


FF Time Series (Tamanrasset, Algeria)

FLASHFlux TISA Version 4A
Daily Average FFv4A and OBS Surface Flux @ TAM



FLASHFlux TISA Version 4A
Daily Average Surface Flux Δ (FFv4A - OBS) @ TAM





FLASHFlux Future Production Strategy

- Both Terra and Aqua are scheduled to be turned off in 2023; production system must be modernized and adjusted to continue production
- Current Plan:

FF Production in S4P

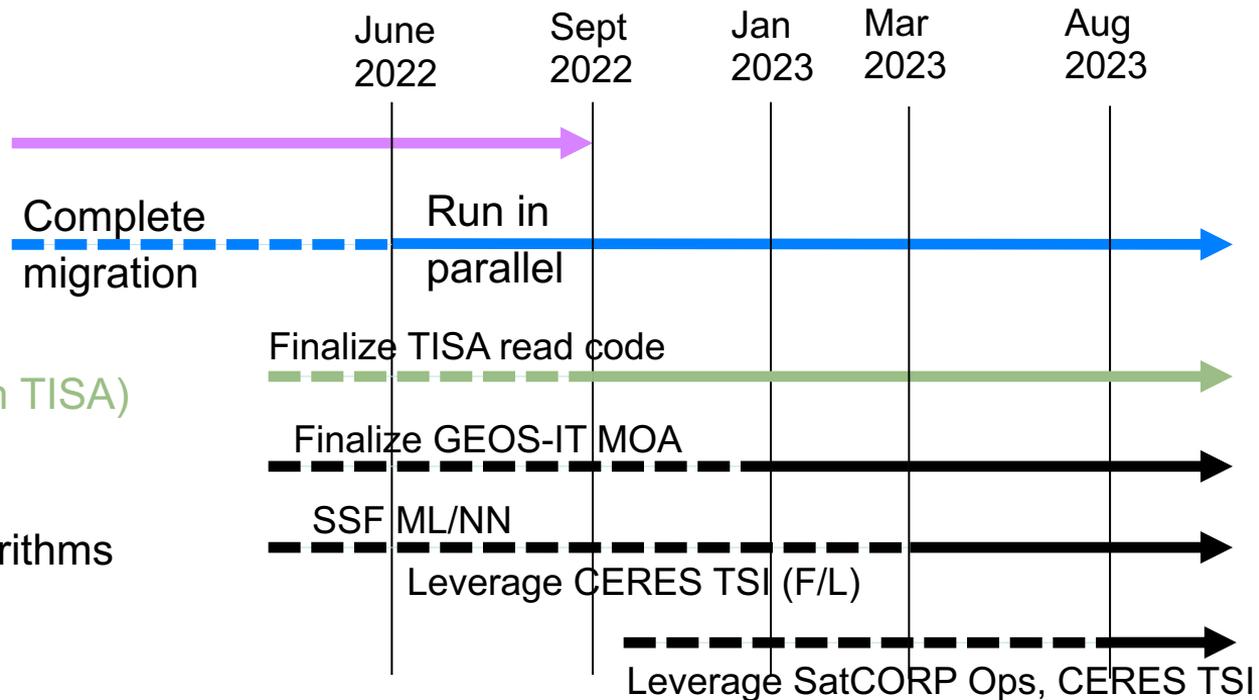
Migrate FF Prod to CATALYST

Promote FF NOAA-20 to CATALYST (replace Aqua in TISA)

Update to GEOS-IT

Upgrade SSF/TISA RT algorithms

Processing GEO for FF (replace lost morning orbit)





FLASHFlux Summary

- **Production with v4A Begun (since Aug 1, 2020)**
 - Operational FF v4A SSF and TISA v4A (since Jan 1, 2019): SSF Terra/Aqua through 4/23; TISA through 4/21 (Aqua production now resuming)
 - New FF Gain+Spectral coefficients beginning Apr 1
- **Validation and Assessment**
 - SSF relative to CRS (Beta), CERES Ed4A SSF (SOFA) and FF and BSRN
 - TISA Daily averages relative to BSRN for Jan 2019 through Dec 2021 (36 months)
- **FLASHFlux Modernization and Updates**
 - Migration to CERES CATALYST reached through FF SSF (also see Katie's talk); Goal June 2022
 - NOAA-20 path requires modifications for CATALYST; upgrade all subsystems; Goal Sept 2022
 - New GEOS-IT sample data; first cut comparisons to FP-IT (still assessing); Goal Jan 2023
 - ML based algorithms for future FF SSF data products (also see Ryan's talk); Goal Mar 2023
 - Migrate configuration to NOAA-20 + GEO (leveraging Ed5 TSI); Goal Aug 2023
- **FLASHFlux Information & Data Provision Through ...**
 - CERES web site and subsetter both SSF and TISA, ASDC (via EarthData) and POWER
 - FF POWER Distribution in last year: ~59,200 unique IPs; > 16M orders; orders >70% low latency
 - 2021 BAMS State of the Climate TOA Flux reports under review



FLASHFlux Web Sites

<https://ceres.larc.nasa.gov/data/#fast-longwave-and-shortwave-flux-flashflux>

Data also served through
<https://power.nasa.gov>



Extras



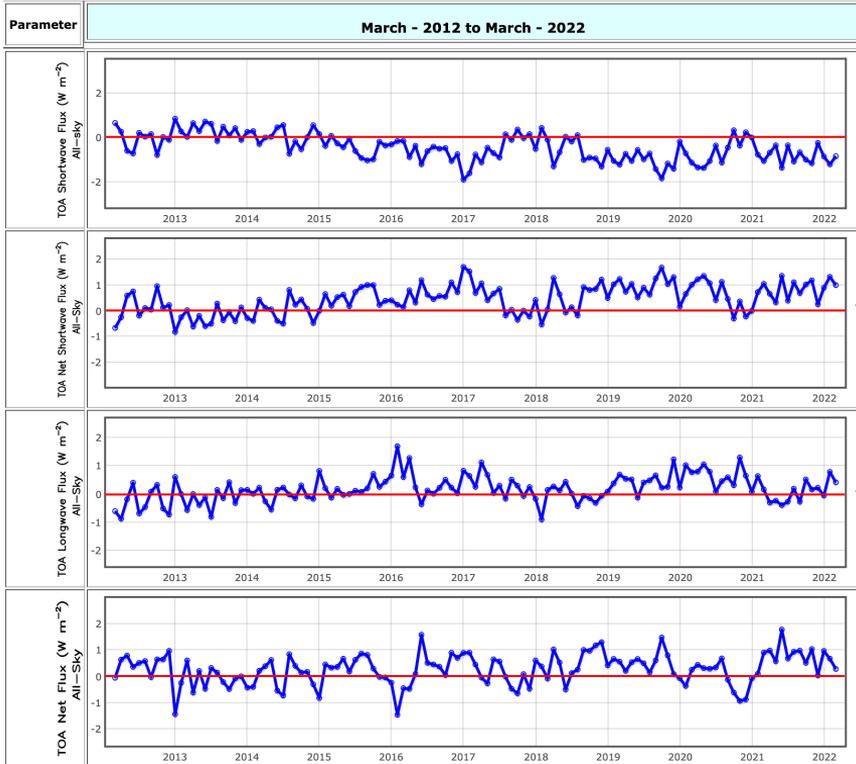
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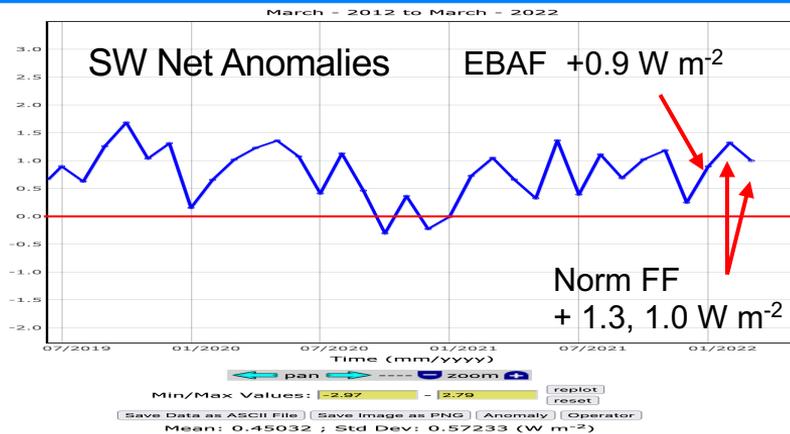
EBAF_FF/ANOM_CERES_EBAF-FF_Ed4.1 - Global Data Charts

March - 2012 to March - 2022

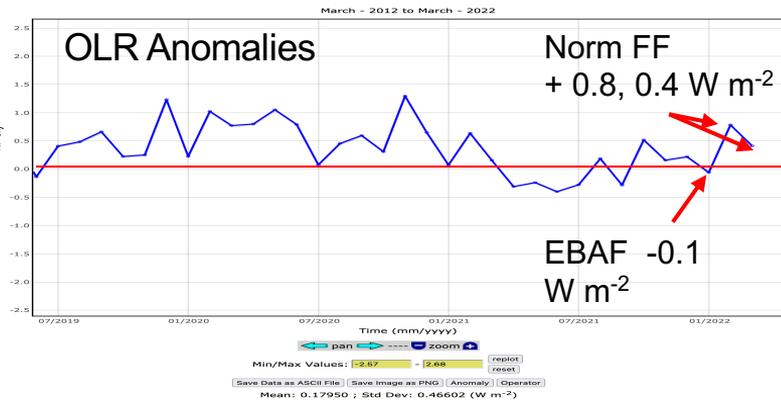
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TOA Net Shortwave Flux (W m⁻²) All-Sky



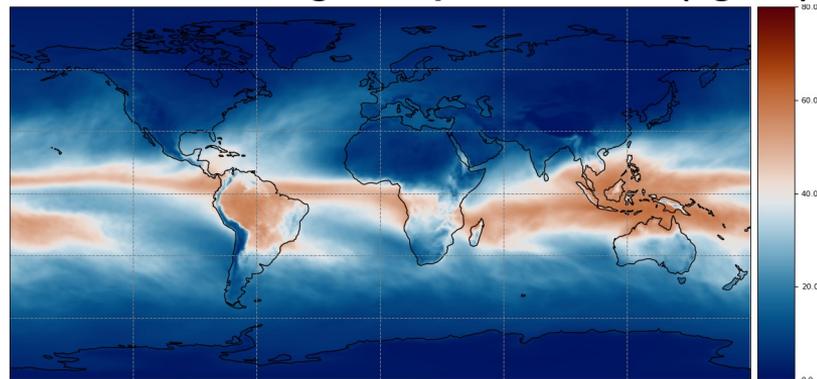
TOA Longwave Flux (W m⁻²) All-Sky





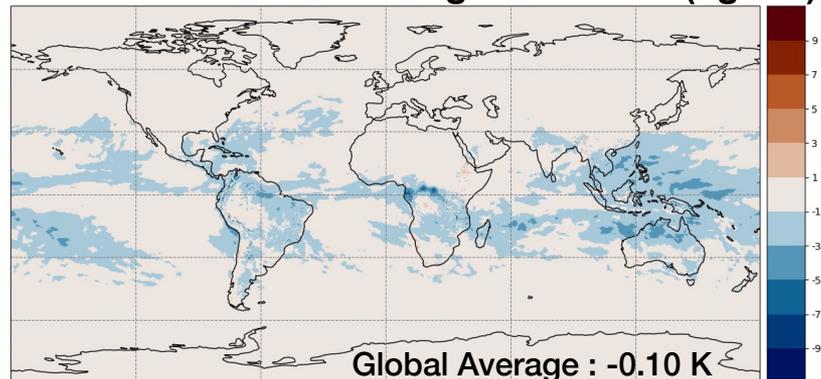
Initial GEOS-IT vs FP-IT Comparisons: PW

GEOS-IT: Mon Avg Precipitable Water (kg m^{-2})

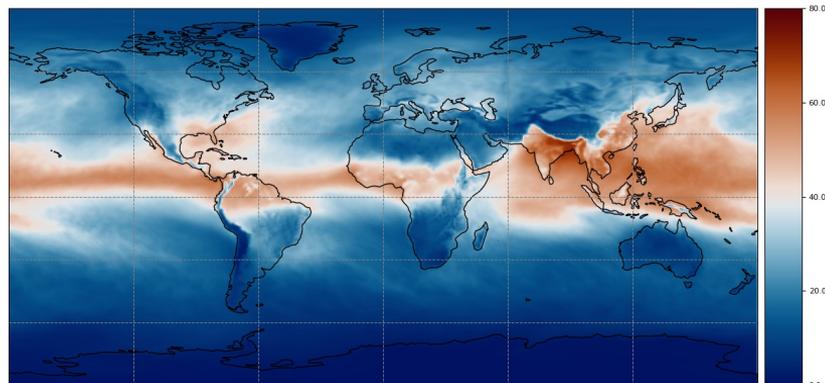


Jan
2018

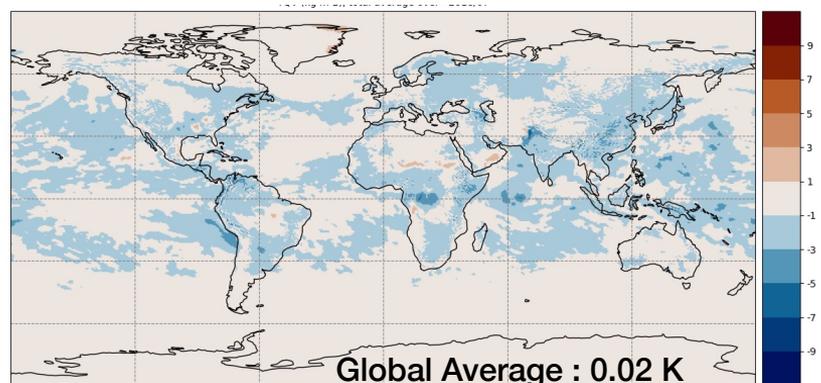
GEOS-IT – FP-IT: Mon Avg Prec Water (kg m^{-2})



Global Average : -0.10 K



July
2018

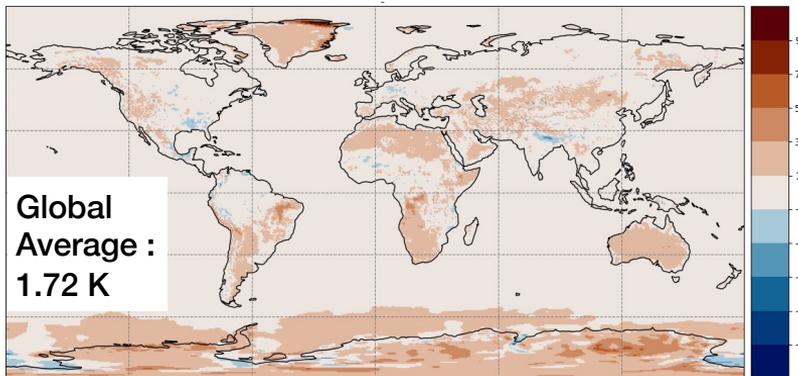
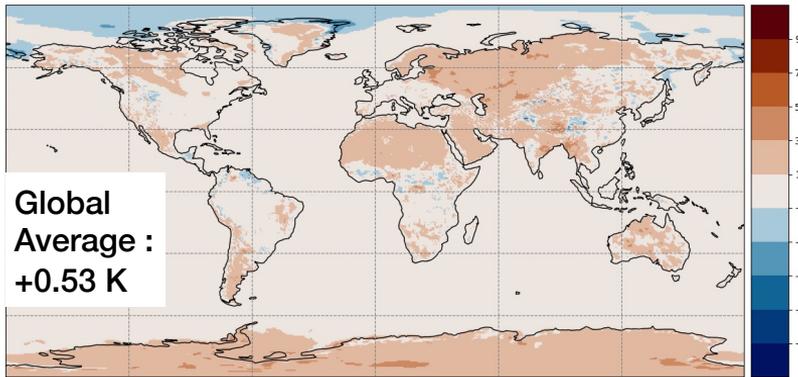


Global Average : 0.02 K



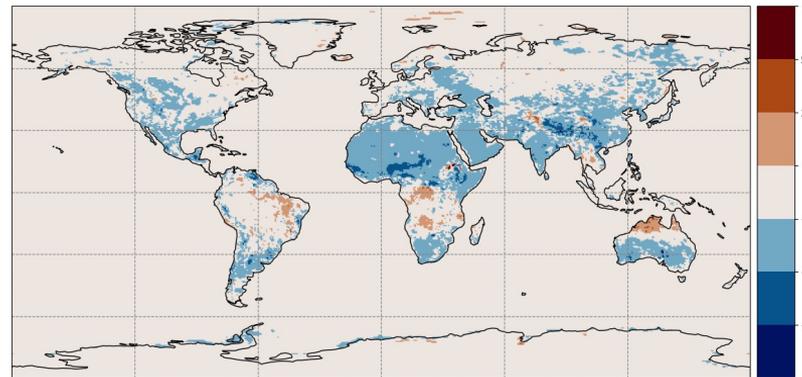
Initial GEOS-IT vs FP-IT Comparisons: T_{skin}

GEOS-IT – FP-IT: Monthly Average T_{2m} (K)

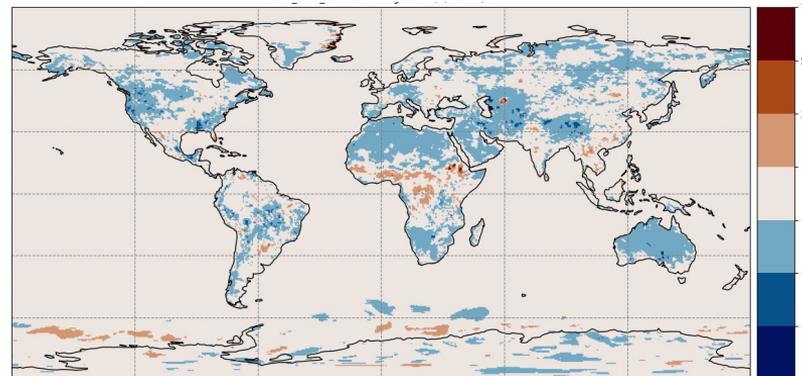


GEOS-IT – FP-IT: Mon Ave Diurnal Range T_{2m} (K)

Jan
2018



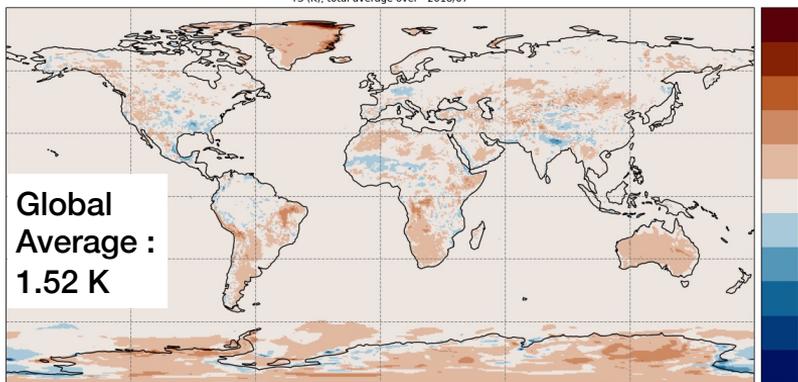
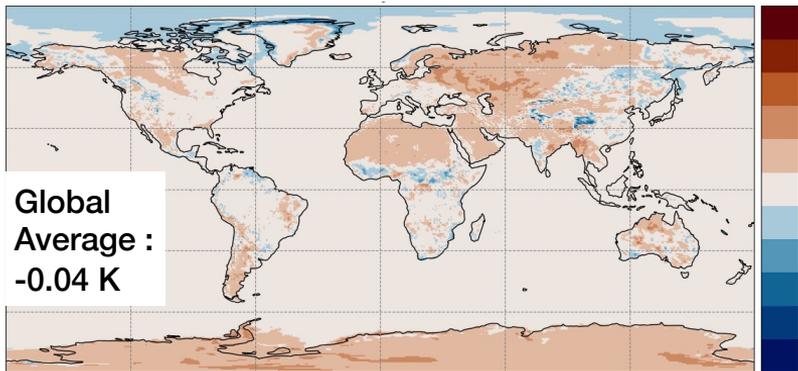
July
2018





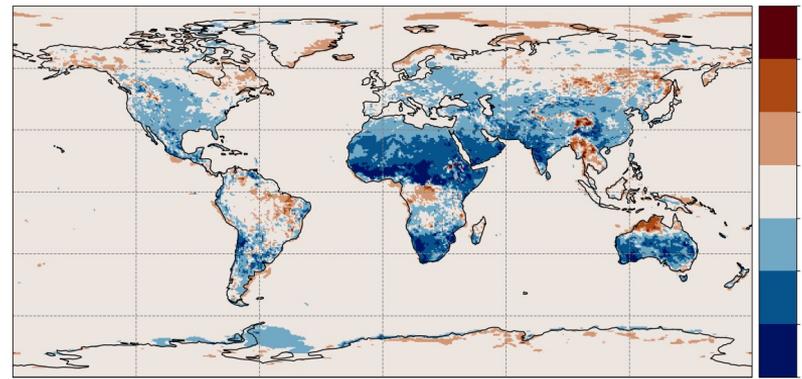
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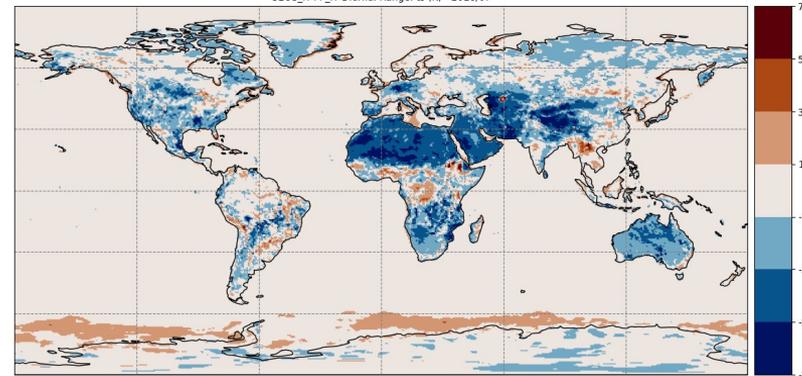


GEOS-IT – FP-IT: Mon Ave Diurnal Range T_s (K)

Jan
2018



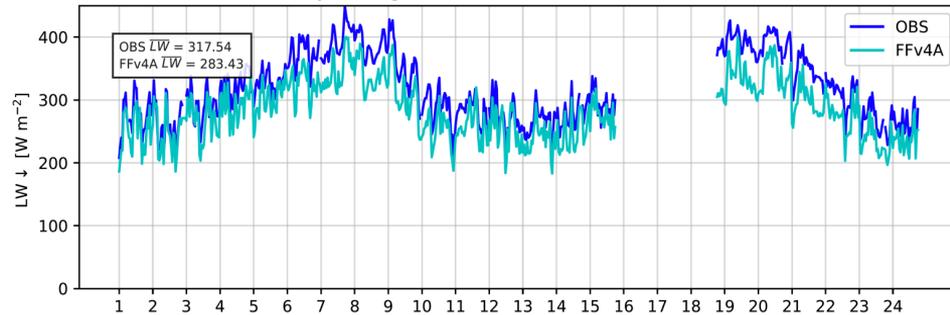
July
2018



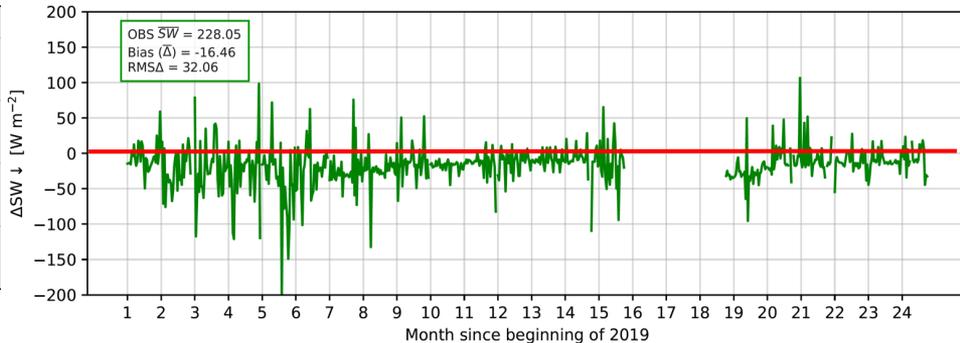
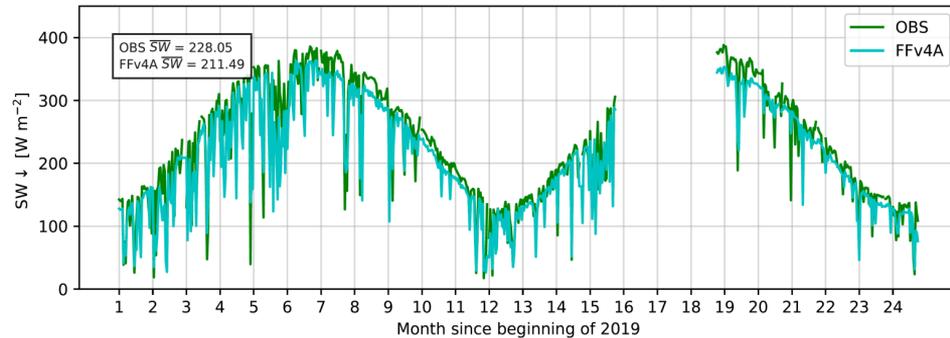
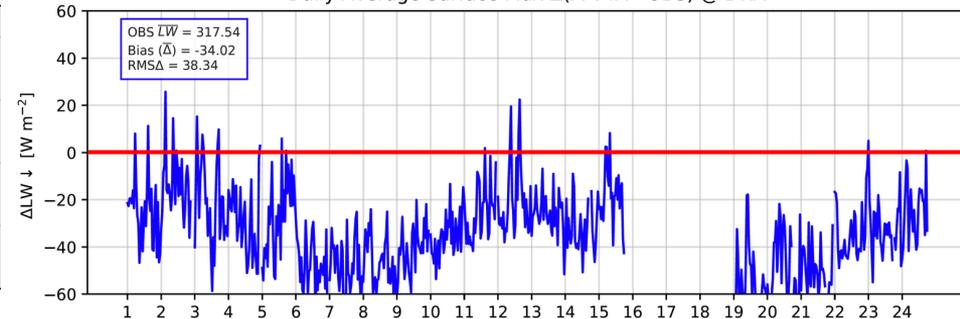


FF Time Series (Desert Rock)

FLASHFlux TISA Version 4A
Daily Average FFv4A and OBS Surface Flux @ DRA



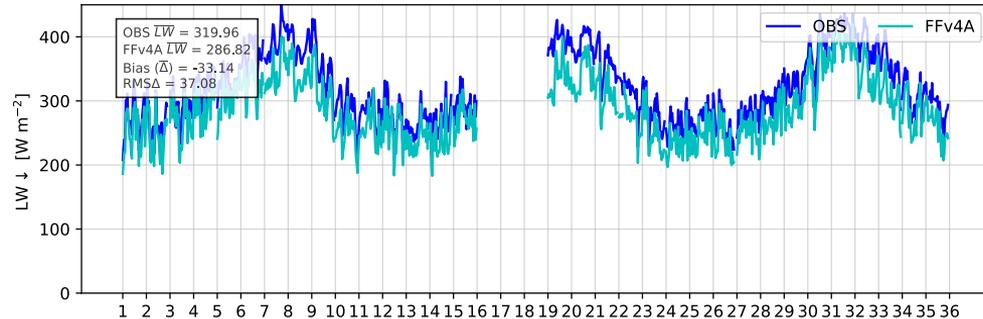
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Daily Average Surface Flux Δ (FFv4A - OBS) @ DRA



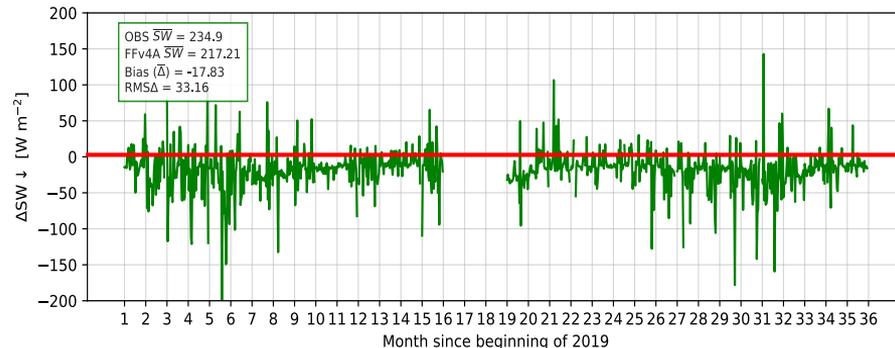
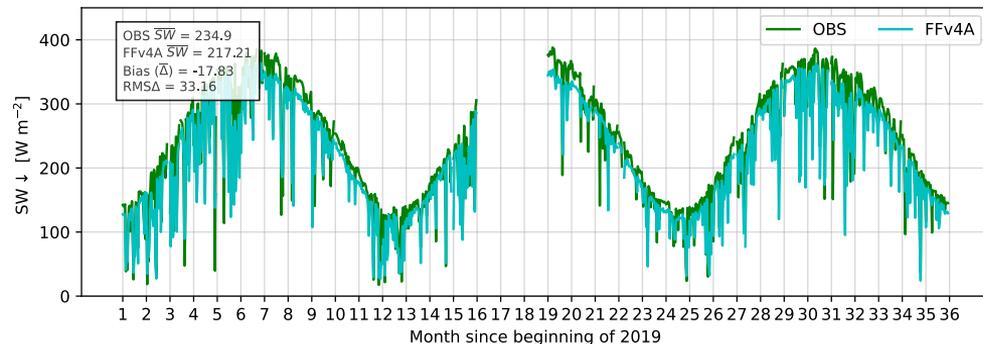
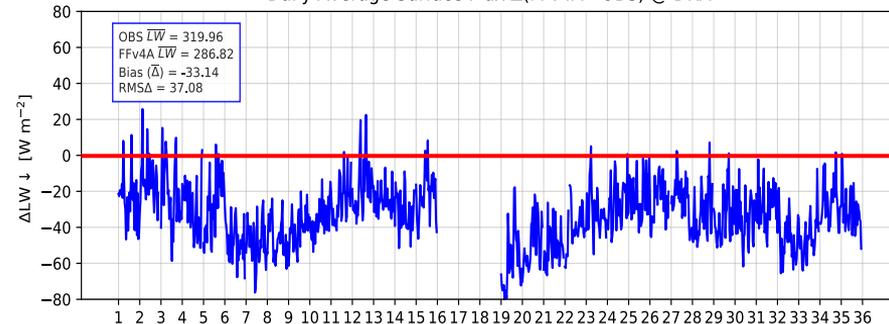


FF Time Series (Desert Rock)

FLASHFlux TISA Version 4A
Daily Average FFv4A and OBS Surface Flux @ DRA



FLASHFlux TISA Version 4A
Daily Average Surface Flux Δ (FFv4A - OBS) @ DRA





Example SSF Validation: Terra and Aqua

Overpass flux validation with BSRN measurements (R. Scott):

- SW Model B implementation shows compensating clear/cloudy; errors to be assessed
- LW Model B seems to underestimate day-time clear-sky more than night

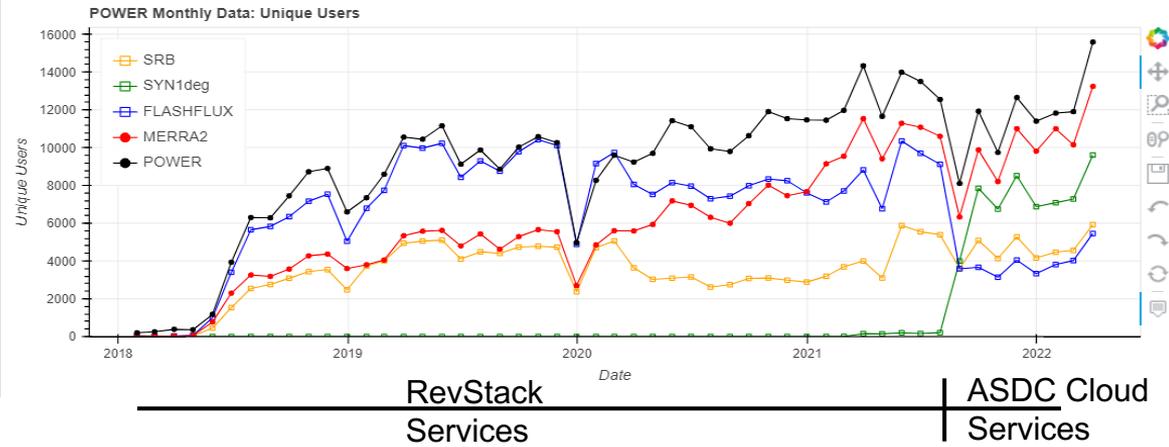
Satellite	Spectral Band	All-sky ($W m^{-2}$)		Clear-sky ($W m^{-2}$)		Cloudy Sky ($W m^{-2}$)	
		Bias	RMS	Bias	RMS	Bias	RMS
Aqua	SW	+15.8 (3.4%)	153.3 (33.7%)	-12.8 (2.0%)	141.7 (22.3%)	36.6 (13.3%)	274.6 (64.0%)
	LW day	-2.1 (0.0%)	27.9 (9.1%)	-14.3 (5.3%)	33.0 (12.1%)	+1.2 (0.0%)	30.3 (9.5%)
	LW night	-1.1 (0.0%)	31.1 (11.1%)	-5.4 (2.2%)	29.6 (11.9%)	-1.7 (0.0%)	33.7 (11.1%)



FLASHFlux Data Delivery via POWER Web Services Portal (2021/03/01 to 2022/02/28)

Orders including FLASHFlux as Delivered via POWER

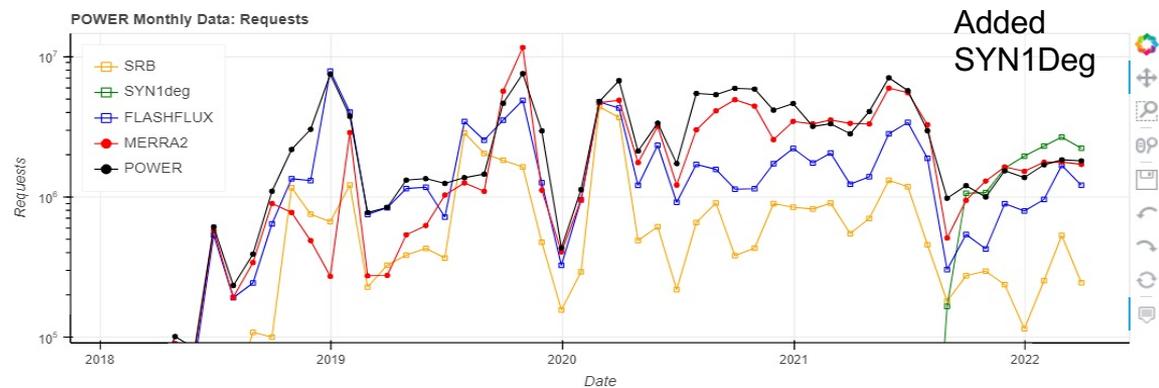
	Total	Monthly
Unique Users IPs	~62.1 K (59%)	~5.2 K
Requests	~16.3 M (60%)	~1.36 M



All Orders including CERES data Delivered via POWER

	Total	Monthly
Unique Users IPs	~105.7 K	~8.8 K
Requests	~ 27.1 M	~2.25 M

(includes SYN1Deg from Jan 2001 through latest month released)





FLASHFlux Data Delivery via POWER Web Services Portal (2021/04/01 to 2022/03/31)

CERES Data Orders Delivered via POWER that include FLASHFLux Data

	Total	Monthly	Avg. Last 3 Months
Unique Users IPs	~59.2 K (64%)	~5.6 K	~4.4 K
Requests	~16.3 M (70%)	~1.36 M	~1.28 M

Dot density map showing locations of users (red) and data request locations (white). Brighter colors show larger frequency at that location.



CERES Data Orders Delivered via POWER including SYN1Deg Data

	Total	Monthly	Avg. Last 3 Months
Unique Users IPs	~51.6 K (56%)	~4.9 K	~8.0 K
Requests	~ 13.0 M (57%)	~1.09 M	~2.39 M

(includes SYN1Deg from Jan 2001 through latest month released)

